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SHORT COMMUNICATIONS

DISCUSSION ON THE PAPER 'CQC AND SRSS METHODS FOR NON-CLASSICALLY DAMPED STRUCTURES' BY R. SINHA AND T. IGUSA[1]

ROBERTO VILLAVERDE
Department of Civil Engineering, University of California, Irvine, CA 92717, U.S.A.

It is interesting to observe how history repeats itself and how each generation re-invents the wheel by ignoring the work of its predecessors. In 1969, Rosenblueth and Elorduy[2] proposed a modal combination rule for systems with classical damping and closely spaced natural frequencies. This rule is developed by modelling ground motions as a stationary white noise and by introducing a correction to take into account, albeit in a crude manner, the limited duration and non-stationarity of ground motions. In 1980, this same rule resurfaces, bypassing the work of Rosenblueth and Elorduy, under a different name: Complete Quadratic Combination or CQC.[3,4] This rule is derived under the same assumption of a stationary white noise, although without an attempt to account for the limited duration and non-stationarity of ground motions. Thus, except for second-order terms, CQC is identical to the expression suggested by Rosenblueth and Elorduy and, not surprisingly, leads to the same results as Rosenblueth and Elorduy's when the ground motion duration is long and the damping ratios are not too small. The latest evidence of this is in a paper by Singh and Maldonado.[5]

The turn is now for the authors, who have extended the CQC rule for systems with non-classical damping overlooking the work of the discusser.[6,7] The rule derived by the authors is based on the assumption of a white noise excitation as the discusser did in his expansion of Rosenblueth's rule for systems with non-classical damping and therefore the two rules are virtually the same. The exception is, once again, the correction to account for the non-stationarity and limited duration of ground motions, a correction that makes Rosenblueth's rule superior over that proposed by the authors when the systems considered have low values of damping or the ground motions are of short duration. Another difference is that in the rule proposed by the discusser, different modal correlation coefficients are obtained for the different degrees of freedom in a system, as these correlation coefficients depend on the phase angles of the mode shapes and each degree of freedom in a mode shape usually has a different phase angle. In the rule proposed by the authors, this dependency is not accounted for.

The authors have also overlooked the work of Maldonado and Singh,[8] who also propose a rule to combine the modes of systems with non-classical damping. In the derivation of their rule, Maldonado and Singh do not model earthquake ground motions as a white noise and do not make the assumption, as the authors did and which may lead, as shown quite convincingly by Maldonado and Singh, to significant errors, that spectral relative velocity and pseudovelocity are approximately equal. Even more, their rule accurately accounts for the correlation with high-frequency modes and the effects of truncated higher modes. Thus, Maldonado and Singh's rule is by far superior to the one proposed by the authors and, for that matter, to the one suggested by the discusser in Reference 7.

As a minimum, the authors ought to justify the need for yet another rule despite the existence of others which have been shown to be superior.

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